CAREER: Nonlinear Optical Studies of Spin and Magnetization Dynamics in Ferromagnetic Multilayers

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Engineered ferromagnetic multilayer thin films are revolutionizing microelectronics. There is promise for a whole new generation of computer and logic devices based on electron spin (Spintronics).

For this field to advance, further studies need to be made of the fundamental electron and spin dynamics in these systems.

Ultrafast nonlinear optical techniques, such laser “pump-probe”, may elucidate information about bandstructure and dynamics, which is often difficult to derive from other techniques. Currently, these pump-probe techniques are being applied to the half-metallic ferromagnets.

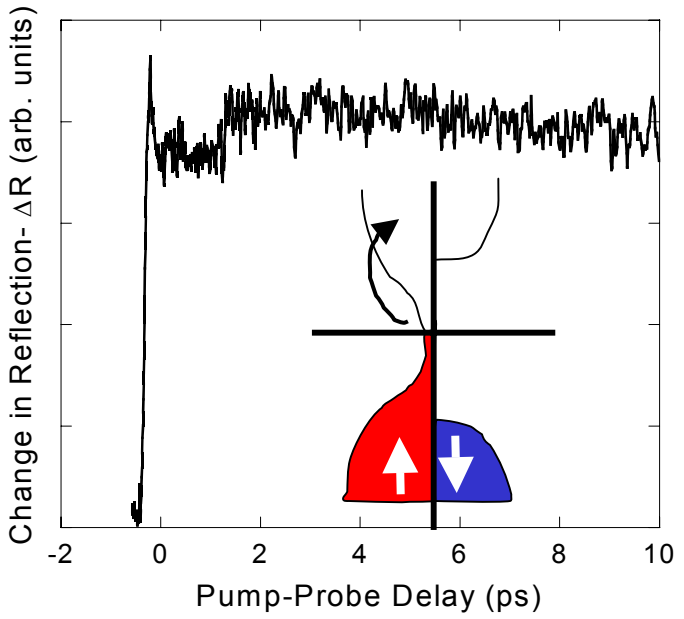

Figure 1: Pump-probe laser change in reflectivity of CrO_2 indicating two component decay, with fast component (~1 ps) due to possible spin-flip. Inset: simplified spin split bandstructure of a half-metallic material.

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Educational:
2 graduate students
4 undergraduates

Undergradaute and graduate students are being trained in magnetooptical techniques, nonlinear laser techniques and the growth and characterization of ferromagnetic thin films.

Educational laboratory modules to teach concepts in modern optics and condensed matter physics are being developed. These modules are being incorporated into the undergraduate laboratories and are being used for outreach.

A series basic physics lectures, aimed at a middle school audience, have been developed based on concepts drawn from physics education research. These lectures have been delivered with great success to local middle schools. One lecture was on “Magnetism”.

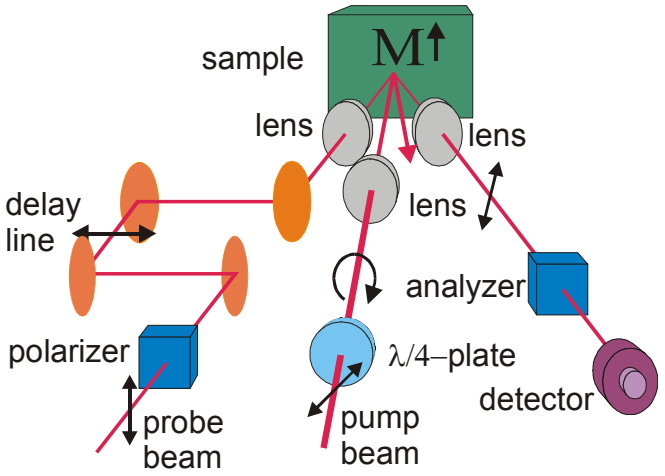

Figure 2. Schematic of an ultrafast pump-probe magnetooptical Kerr setup for studies of spin dynamics in ferromagnetic thin films.